It's Electric!

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Target Grade: 9-12 Physical Science

Time Required: 7.5 Hours

Standards:

TN State Science Standards:

- PSCI.PS2.7: Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field.
- PSCI.PS3.7: Demonstrate Ohm's Law through the design and construction of simple series and parallel circuits.

NGSS:

- HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known
- HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

Lesson Objectives:

Students will:

- Create an artistic game using circuits.
- Calculate and solve problems related to current, resistance, and voltage in a series.

Central Focus:

The central focus of this lesson is create a design to remember simple circuits and understand material related to electricity. This includes but is not limited to Ohm's law and various problems to solve for electricity.

Background Information:

The basis of this lesson is for students to understand and gain knowledge on simple circuits. Students need to understand the function and basics of electricity. For this lesson students will be designing a game board that will have functioning lights. The students will create their own questions and will just need to be given the materials for

this lesson which are listed below. This allows for students to have a hands on experience with circuits.

Materials

- Poster paper 18" x 24"/ one per student
- Adhesive tape/ 2 per student
- Heavy duty aluminum foil 75 feet/ one per student
- String of Christmas lights
- Hole punchers / one per student
- Alligator clips 2 per battery
- 9 V batteries/ 6 per class
- Insulated copper wiring 18 gauge
- Wire strippers / one
- Index cards/ one per student
- Balloons/one per student
- Empty soda can/ one per group of students
- Computer, online access, projector
- Project sheet/one per student
- Student white boards and markers/ one per student
- Any handouts, articles, presentations, online videos listed in this section should be included

Instruction

This lesson will need to be spit over multiple days. The time above includes time for students to work at home.

Opener (15 minutes):

To start the class, give the students the KWL chart and have them complete the K for know and W for want to know on the topic of

Each student will be given a balloon to blow up and tie off. The teacher will instruct the students to rub the balloons on their head to demonstrate static charge. The teacher will then present the student with the task of having the balloon sticking to the table. Students should be given 2-3 minutes to be able to complete this task using prior knowledge and other information. Then the students will take that balloon and put it near an empty soda can on a flat table and watch what happens. The students should see the soda can roll on the table to show charge induction. The following video clip can be shown to illustrate this
https://www.youtube.com/watch?v=eZpaLbygMIA&disable_polymer=true

Direct instruction: (90 minutes, or 45 minutes over two days)

In the next part of the lesson the students will be introduced to the concept of current, resistance and Ohm's Law, conductors and insulators, and how batteries work. This will be done via discussion. It will be related to objects in their daily use such as household appliances, charging cell phones, and lights.

After that the students will be introduced to series and parallel circuits. They will be shown Christmas lights to illustrate a series circuit. To illustrate a parallel circuit, the teacher will take two lights and connect them in parallel to the battery to show the students what will happen if one light goes out.

The following link leads to the video that would discuss series and parallel circuit: https://www.youtube.com/watch?v=x2EuYqj_0Uk

Exploration: (5 hours, some time can be assigned for at home)

The students will then be given a project sheet (see attachment) showing previous project examples to show what is expected of them.

Prior to implementing their game on their large poster circuit boards, they will create a sample board on a 3x5" index card with 3 sample circuits.

To create the game circuit boards, each student will develop 13 different questions and answers to a given topic that they have chosen (see rubric & attachments.) The students will have several class periods to work on their series circuit board. They will be integrating art into their projects through drawing their graphics, obtaining them from magazines, or via graphics from the internet. The students can also choose a topic for their boards that they find relevant and interesting; i.e. Math, history, literature, or foreign languages.

The students after completing the game will attempt to play it to test if it works or not. The students from there will write a small review on what could be fixed or what worked.

Closer: (45 minutes)

The students will receive a handout with a Venn diagram as well as a KWL chart (please see attachments for these documents). The students in the Venn diagram need to compare and contrast series and parallel circuits. For a final wrap up, the teacher will discuss the target of lesson, the objectives, and discuss the standards.

Differentiation

The project can be edited for all levels. For those who need, it can be shortened by half for those who need. For those with language barriers, using tools on a google chrome extension (i.e.: snap and read or co-write) or iPad apps can be used to help translate from one language or the next. ESL students are also able to do it in their own language if needed. Other aspects like pre-cut poster board and aluminum foil can be arranged for those who need as well.

Assessment

Formative Assessments:

Student responses in the opening exercise.
KWL Chart
Venn Diagram

Summative Assessment:

Circuit game project

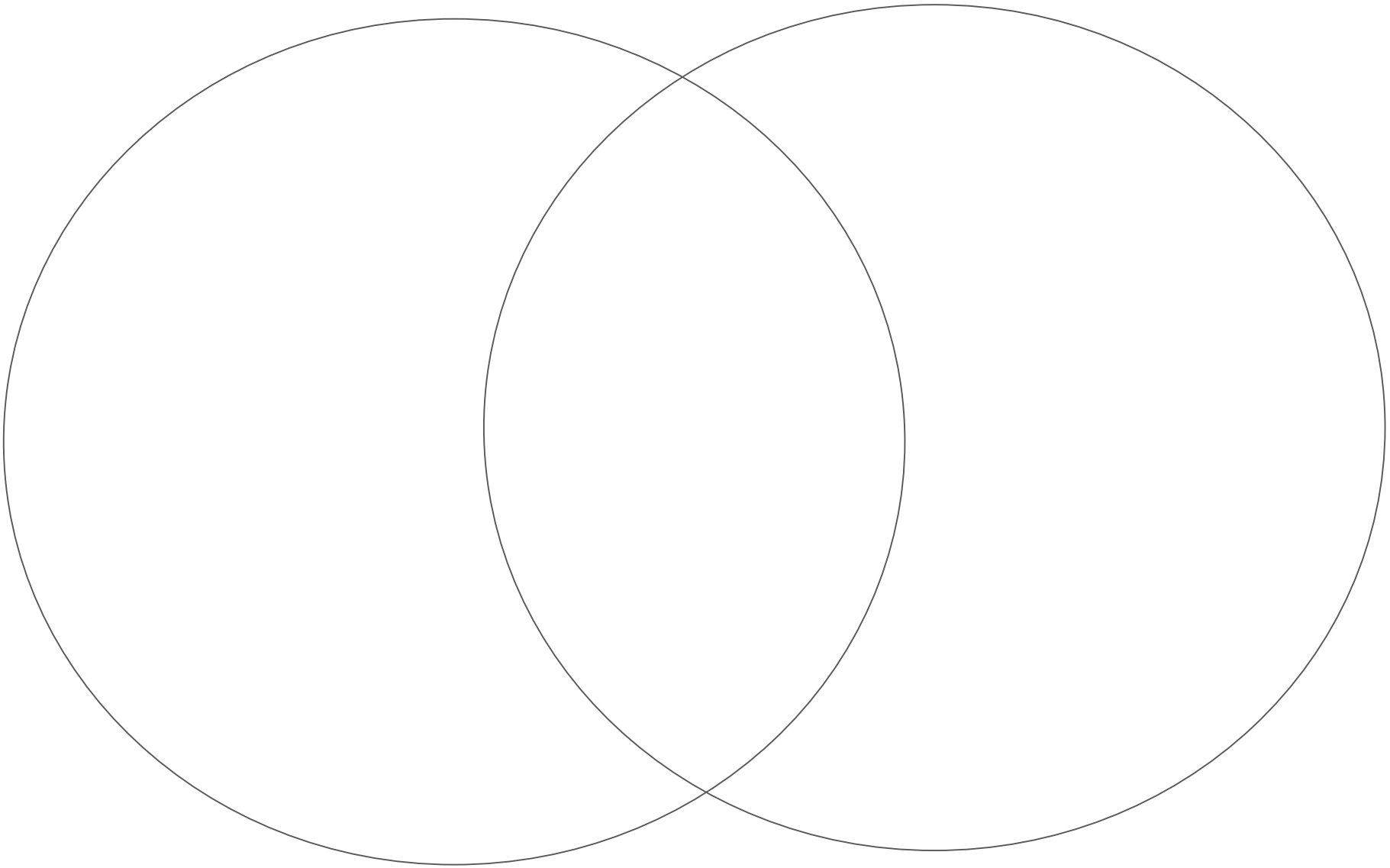
KWL Chart

Topic: _____

What do you know K:	What do you want to know K:	What did you learn L:

Venn Diagram

Compare and Contrast: _____



Topics for Circuit Project

- Songs and artists
- NFL/ NBA players and numbers
- Teams and mascots
- Cartoon characters
- Famous couples
- Movies and actors
- Movies and songs
- Books and characters
- Flags and countries
- Math problems
- English to French
- English to Spanish
- English to another language
- Text slang
- First and last names
- TV shows and characters
- Fashion logos
- States and capitals
- Countries and capitals
- Cars (model pictures)
- Colors
- Animals and pictures
- Food and countries
- Shoes and logos
- Scientists and inventions
- Brands and logos
- Foods and pictures
- Couples at school
- Words and definitions
- Words and definitions for a young child
- Quotes from movies
- Academic questions and answers

Plan for your project here:

Circuit Board Science Rubric

Category	10 points	8 points	5 points	2 points	0 points	Category score
Preliminary Card	All 3 examples are complete and each light works properly.	All 3 examples are complete and most of the lights work properly.	2 of 3 examples are complete and most of the lights works properly.	1 of 3 examples are complete and most of the lights work properly.	Work is not complete and lights do not work.	
Neatness & Organization	The overall card has an excellent, neat appearance and is well laid out.	The overall card has a good appearance and is well organized.	The overall card has only a fair appearance.	The overall card has a poor appearance and is disorganized.	Work is not complete.	
Front of board (graphics)	Multiple colors were used and at least 10 different graphics are attached.	Several colors were used and at least 8 different graphics were used.	Some colors were used and at least 6 different graphics were used.	Little to no color was used and less than 6 graphics were used.	Not complete.	
Front of board (lettering)	All lettering is clear, attractive, and easy to read.	Most lettering is clear, attractive, and easy to read.	Some lettering is clear, attractive, and easy to use.	No lettering is clear, attractive, or easy to read.	There is no lettering.	
Back of board (crossing of questions)	At least 3 questions crossed over 6 spots.	At least 2 questions crossed over 6 spots.	At least 1 question crossed over 6 spots.	No questions crossed over 6 spots.	Not complete.	
Back of circuit board (proper lighting works)	All answers light up once.	There was only one “double” light or 1 light not working	There was only 2 “double” light or 2 lights not working.	3 or more of the answers lit up more than once or 3 or more are not working.	Not complete.	
Variety of Questions	All questions are clear, different, and have accurate answers.	There are 1-2 duplicate, inaccurate, or not clear questions or answers.	There are 3-4 duplicate, inaccurate, or not clear questions or answers.	There are numerous duplicate, inaccurate, or not clear questions or answers.	Questions not complete.	

Circuit Board Science Rubric

Category	10 points	8 points	5 points	2 points	0 points	Category score
Grammar and spelling	All spelling and grammar on the board is correct.	Most grammar and spelling on the board is correct. (2 or less mistakes)	The grammar and spelling on the board is fair. (3-6 mistakes)	There are numerous grammar and spelling mistakes (6+).		
Cooperative work/ behavior	The student was able to work on the project without being distracted.	The student worked on the project with 2 or less redirections from the teacher.	The student worked on the project with 3 or less redirections from the teacher.	The student worked poorly on the project with 4 or more redirections from the teacher.		
Overall effort	Board demonstrated excellent effort and work.	Board demonstrated good effort and work.	Board demonstrated fair effort and work.	Board demonstrated very poor effort on the project.		
Total Score						

Teacher comments on the project:

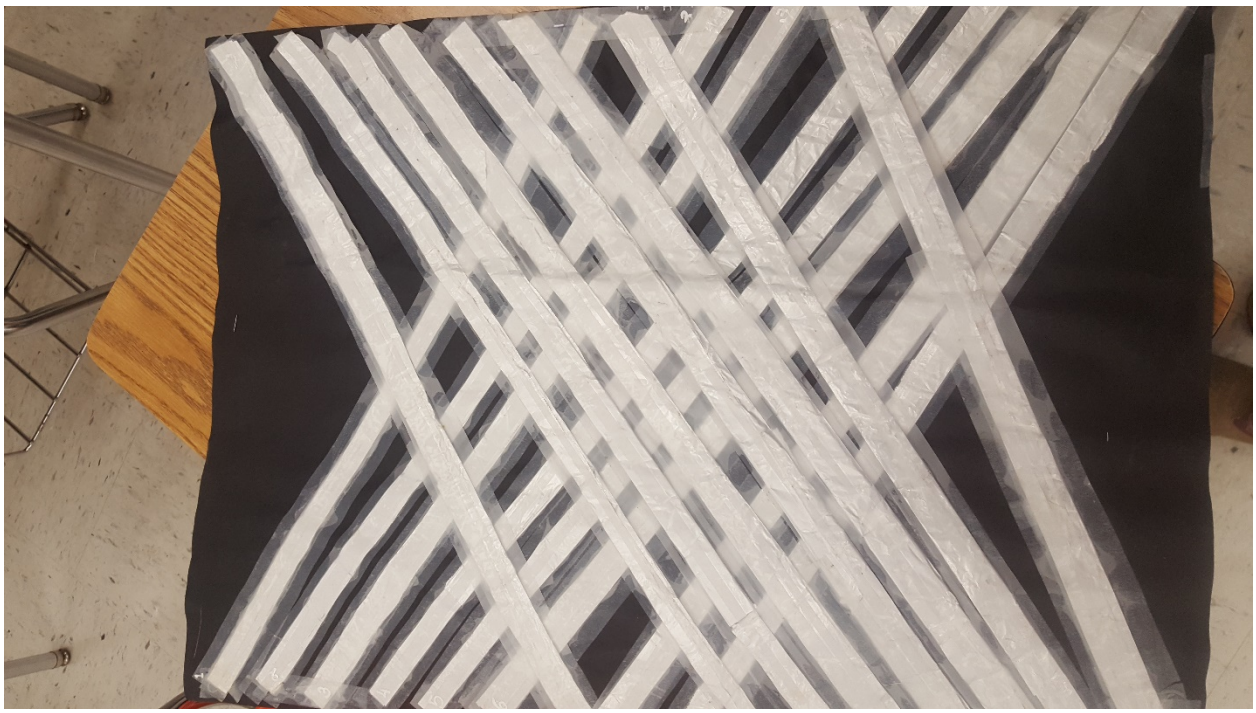
Circuit board project

You will create a series circuit board game in class. You will be given 4 class periods to work on it. If you need additional time, you may come during your study hall to work on it.

You will need a roll of heavy duty aluminum foil, 2 rolls of adhesive tape and one poster paper that I will provide to you.

You will need to develop 13 different questions and answers on the front of your board. The goal is to have your board light up only once for the question to the correct answer.

You will need to cut strips of aluminum foil. The strips of foil will be cut to reach from the question side of the poster paper to the answer side. See teacher example:



You will cover the strips of foil with adhesive tape. If you get more than one light to light up after testing it with the battery, alligator clips and light tester, you will need to problem solve and determine how to rewire the back of the poster board to get it to work correctly.

Your goal is to have one question and only one answer light up on the front of the board.

See the rubric for all required elements needed for this game project.